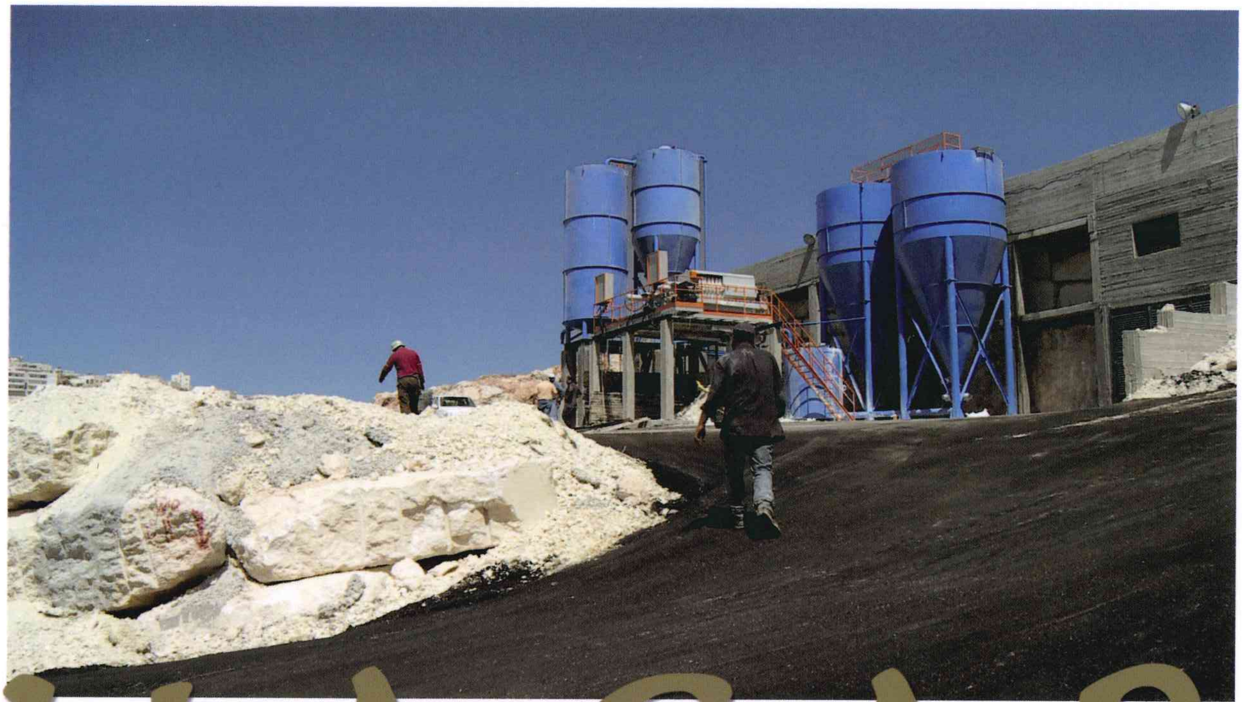
LIFE THIRD COUNTRIES PROGRAMME TCY/GA-000115



# HAGAR

## GUIDELINES & BEST PRACTICES

THIS BOOKLET WAS CREATED BY THE PALESTINIAN MARBLE DISTRICT TEAM WITHIN THE FRAMEWORK OF THE PROJECT HAGAR FUNDED BY THE EU UNDER THE LIFE THIRD COUNTRIES PROGRAMME

Project Hagar – TCY/GA 000115 Life Third Countries
P a l e s t i n e
Guidelines and Best Practices

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## Guidelines & Best Methods
## To assess, build and recycle marble sludge at cluster level

### Contents

## 1. Objectives

The goal of this document is to develop a set of recommended procedures that are issued as guidance to the Municipalities, utilities and donors active in the field of recycling marble by-products (sludge, debris, water and calcium carbonate).

## 2. Definition

**2.1 "Best Practices"** are methods which have been determined to be the most effective, practical means of preventing or reducing pollution generated by the marble industry.
In order to identify and adopt best operating practices and take full advantage of economies of scale, the Palestinian Marble District (PMD) has decided to standardize field service operations, using the plant designed and implemented in the "al-Fahs Cluster" (Hebron, Palestine) as benchmarking.

**2.2 "Production District"** (cluster), terminology gained through Italian experience, is a concentration of specialized SME which produces a structured industrial area, with common services, experiences and needs, encouraging the competitiveness of the products in an integrated way and allowing for the creation of employment opportunities and Best Practices exchanges.

The Marble Production district is an essential component of the Palestinian production structure, located in the Governorates of Hebron and Bethlehem, and comparable to the Italian SMEs-based economy, with a high concentration of quarries and stone cutting companies in the relatively small area of the two provinces: Verona and Massa Carrara.

### 2.3 Other useful terms

**Calcium carbonate:** The chemical substance of which marble is principally composed.

**Plate frame:** A kind of filter used to extract calcium carbonate from wastewater allowing the recycling of water and the collection of calcium carbonate (25% humidity).

**Filter press:** The machine used to press the sludge.

**Sludge:** The suspension of calcium carbonate (marble powder) in water resulting from the sawing and polishing action of machinery in the marble industry. The density of the liquid depends on the concentration of powder in the water.

**Mud:** The suspension resulting from the vertical sedimentation process.

**Vertical sedimentation:** Technique used in order to concentrate the content of calcium carbonate in wastewater.

**Flocculent Chemical:** substance to speed up the decantation process of the mud / sludge.

**Debris:** "Marble and stone debris" or "debris" means those solid materials resulting from the extraction, alteration, construction, destruction, rehabilitation, or repair of marble and stone or their manufacture.

**Sludge:** "Marble and stone sludges" or "Sludges" mean the liquid residuals from the marble and stone's cutting and production, mostly with cutting machinery like H/V Cutters and Circular Cutters, composed of water and stone powder in percentage not less than 90%. Solid residuals from mining and extracting activities destined to the effective use for ground filling do (may) not constitute waste and therefore are excluded from the application of these rules.

**Operators:** "Operators" refers to any subject, singular or under any company denomination or organization, which operates for commercial purposes within the above mentioned activities.

**Facilities:** "Marble and stone debris and sludges facility" or "facility" means any site, location, tract of land, installation, or building used for the disposal of debris and slude

**Disposal:** "Disposal" means the discharge, deposit, injection, dumping, spilling, leaking, emitting, or placing of any marble and stone debris and sludges into or on any land or ground or surface water or into the air, except if the disposition or placement constitutes storage, reuse, or recycling in a beneficial manner.

**Licensing Authority:** "Licensing authority" means a city or county department which is approved by the Hebron district authority.

**Storage:** "Storage" means the holding of debris and sludge for a temporary time period and in such a manner that the debris and sludge remain retrievable and substantially unchanged and, at the end of the period, are disposed, reused, or recycled in a beneficial manner.

**Contractors:** "Contractors" means the owners and the operators of authorized marble and stone debris and sludge facilities.

**PMD:** "Palestinian Marble District" is the non profit and non governmental organization, established by the partners for the management of the Hagar Project and to disseminate project outputs. PMD is composed by private and public stakeholders in Palestine and Italy

## 3. Summary

**3.1.** Worldwide, tens of millions of people suffer from improper disposal of solid wastes-- through contamination of air and water, and as a vector for transmission of disease, to cite just a few consequences. In some countries (such as Italy, India, Romania, Brazil, etc.) marble processing facilities are a major environmental pollutant, generating a series of major environmental problems, which affect public health, the sustainability of the natural resources, particularly water, the landscape and the living conditions of the population.

**3.2** With around 300 quarries and 600 stone cutting companies this is the most important Palestinian industry and the 12th largest of its sector in the world. This high production in a relatively small area creates a series of major environmental problems: air pollution, degradation of the landscape, solid waste dumped on nearby road sides and sludge disposed in open areas where it clogs the soil pores resulting in soil and plant damage.

The landscape and the territory are negatively affected by the methods of excavation applied in the quarries, by the cutting of marble blocks and the irresponsible dumping of sludge near to the houses and in public areas : In some traditional Palestinian hills a 'moonscape effect' is arising, destroying the traditional profile of the district and creating, in the meantime, serious air pollution problems and sickness among the population due to the dust concentration ( < 4 micron ). Furthermore, the marble industry creates wastewater of around 750.000 m3 a year. With 1,8% of the world production, the Palestinian stone and marble output is almost double that of Germany's, half of Turkey's and 70% of that of the US. The annual Palestinian production of finished stone and marble is 16 million square metres with annual sales at around 400/500 million US dollars. This industrial sector also has an important social impact as it employs over 15.000 workers and represents 5% of the GDP of the Palestinian economy. However signs of economic difficulties, production reduction and export limitations are registered since 2006.

**3.3** The heart of this industry is to be found in the Governorate of Hebron and Bethlehem, where around 75% of national production is located

The Hebron District is located 36 km. South of Jerusalem City, in the Southern part of the West Bank, with a total area of 105.000 hectares. The district has been controlled by the Israeli occupation since 1967 and has a limited autonomy under the 'Taba Agreement'. The estimated total population of the district is around 270.000, 33% of whom live in Hebron City. Hebron is an agricultural marketing and trade center and the major industrial activity in the district is represented by stone and aggregate quarrying together with stone and marble cutting. For the quality and quantity of its production Hebron, with the boundaries area of Bayt Fajjar and Bethlehem, can be considered as the capital of the Palestinian marble industry.

**3.4** The European Commission has co-financed, under the Life Third Countries Programme, our project "HAGAR – ENVIRONMENTAL ACTION FOR THE SUSTAINABILITY OF NATURAL RESOURCES THROUGH RECYCLING OF WATER AND SLUDGE FROM MARBLE PRODUCTION" (TCY/GA/000115) aimed to establish:

1. A new environmental regulation in the Hebron Municipality for the treatment of debris, sludge and water from the marble industry;
2. A network between the Palestinian and the Italian marble stakeholders, with the aim of transforming knowledge and adopting applied models for common environmental problems;
3. A methodological model for the recycling of industrial wastewater and separation of calcium carbonate.

*The project has been implemented by the Hebron Municipality and the Italian NGO Agenfor Italia, between December 2006 and July 2008.*

For further information please check the project web portal **www.lifehebron.com**

**EXAMPLE OF TANGIBLE OUTPUTS**

1. Levelling and construction of the platform for the prototype, recycling debris and stones from the area.

2. The production of recycled water from the sludge collected and treated in the new established cluster.

***Hagar, Final Repor, 30-10-2008***

## 4. Methodology

These Guidelines result in a best practice guidance document with two stages of realiszation. The first stage describes methods that the large majority of Municipalities in Palestine could reasonably implement to assess the conditions and needs in establishing a specific utility in the field of by-products for marble processing facilities and which would provide the important benefits outlined above. A second stage describes technical and managerial practices for the implementation of these recycling facilities. Each level describes the recommended data elements and options for project implementation.

**Best Practices**

**Stage 1**
The foundation of proposed best practices consists in the definition of an assessment methodology element for stage 1. This methodology is selected to provide the minimum information required to determine basic parameters for the design and implementation of a usefulness in recycling water from marble processing plants and allowing performance reference.

**Stage 2**

The foundation of proposed best practices consists in the definition of a number of procedures, applied technologies, in the form of recycling plants or technology for the re-use of abandoned quarries, to provide municipalities, donors and other environmental professionals with practical tools and methods and enable them to make a number of political decisions based on current conditions and performance indicators. For example, it is necessary to identify deficiencies and solve pretreatment and filtration problems, and optimize the operation and maintenance of rapid gravity and pressure filtration plants at a cluster level, as well as to define a project methodology for the integrated re-use of abandoned quarries and the dumping of calcium carbonate.

Production of dehydrated calcium carbonate in the al-Fahs plant with a humidity level of 12%

## 5. Stage 1: How to assess quantity of sludge, debris and water produced in a specific territory.

**Description of the activity**

The objective of this activity is to quantify the amount of sludge (water and calcium carbonate) and debris produced by the marble industry in a specific area and the impact that these potentially harmful waste products may have on the environment.

The data collected during this assessment will also be used as the basis for the definition of the most appropriate size of the pilot plant to be built as part of the environmental mitigation policy and this makes the collection of accurate and reliable data extremely important.

**Problems encountered:**

During project implementation what was needed was to establish whether or not the official estimates were accurate and, on the basis of the findings, calculate the parameters necessary for the construction of the recycling plant and for future projects of a related nature.

Are there really 60 stone processing facilities in Hebron today?
Does the generation of stone debris really amount to 110.000 tons/year?
Does the quantity of sludge produced actually correspondto 20.000 tons/year or is it less?“

(Hagar Project Assessment, Vers. 4.0 July 4, 2006)

The assessment confirmed that in a number of cases, official data cannot be considered fully reliable.

(ANNEX 1 : Assessment findings in the al-Fahs District)

## Stage 1: Best Practices for assessment methodology

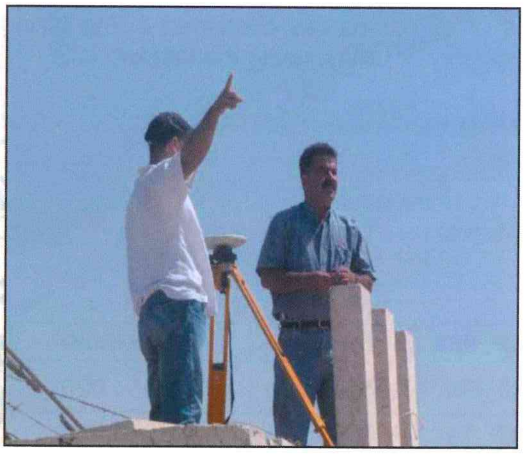
### 5.1.1 Step 1: The 4 Preliminary Elements

In order to carry out a correct assessment effectively the following four preliminary key elements must be clearly defined:

1. The exact area to be covered by the research activity and an estimate of exactly how representative this area is of the whole Governorate or the related Cluster.
2. The number of companies and their precise location to be visited and assessed;
3. An evaluation grid to be drawn up The grid must provide details that are measurable and comparable.
4. A model for the accurate analysis of the sludge samples. In particular, composition of the sludge, the water and calcium carbonate.

### 5.1.2 Step 2: GIS Technology combined with GSM

In order to be effective, the research needs to digitalize the whole process of data collection and use a system capable of relating this information directly to the geographical location in which they were found. The system suggested in this Guidelines is that of a Geographical Information System (GIS) combined with GSM for the geographical mapping. This technology is a computer-based data collection, storage, and analysis tool that combines previously unrelated information into easily read maps from which it is possible to perform complex analytical functions. The results of these analyses are then displayed in the form of maps, tables or graphs, allowing decision-makers to visualize much more clearly the data that would otherwise only be accessible to statisticians or database experts, and then select the best course of action.
Moreoever, Internet, and GIS offer a consistent and cost-effective means for the sharing and analysis of geographical data among government agencies, donors, private industry, non-profit organizations, and the general public. Therefore, the recommendation of this solution is a natural step, and it proved to be very effective in the Hagar project assessment
GIS technology can also be recommended for another specific technical reason; to define the exact area of intervention. This is because traditional cartography and maps are not accurate enough for the purpose of this research and do not allow for the automatic connection of data with their relative spatial locations. Updates to the existing or newly generated databases may be consulted via maps in real time, either by working on the local server or via the web portal. The mass of information made available to the user is determined by two factors: the amount of information (and the range of subjects) on the database and the complexity of the software for reading the database. Generally speaking, information regarding geographical, social, political, environmental, and demographic information will be dealt with.



GIS uses layers, referred to as "themes," to overlay different types of information, much as some static maps use Mylar overlays to add levels of information to a geographical background. Each theme represents a category of information, such as roads or industrial areas

As with the old Mylar maps, the layers which are underneath remain visible while additional themes are placed on top With GIS technology different maps of the area have been overlaid so as to identify basic parameters:

Streets and districts, Solid Waste collection, Pipe Water Network, Sewerage Network, Electricity Network.
*In order to standardize and exchange information use of the Palestinian Coordination System.*

### 5.1.3 Step 3: Data Mining

The third major methodological problem for our guidance strategy is how to go about the identification of suitable sources of information for the research activities.

Status quo registered by the Hagar Assessment:

*"In Palestine there are currently no reliable registers holding details of companies involved in the marble production chain, or for that matter, in any other sector. Even the definition of marble company is foggy. In some cases the quarries from where marble is extracted are not even authorized by public bodies, but simply owned and managed by private entrepreneurs acting illegally and with no interference from the public authorities. This results in a lack of control over the work being carried out and often serious abuse of even the most basic safety and environmental procedures. This phenomenon is common to the cutting facilities and any other productive or commercial activity. In order*
*In order to begin conducting our survey we needed to know the exact number of existing companies, their location and at the very least the names of their owners, so as to allow our team of data collectors to fix an appointment for the respective interviews.To obtain the above information, we soon realized that local, unrecorded information was of the utmost importance if we were to get closer to a clear picture of the real situation. For this reason, we adopted a networking methodology combined with a data mining strategy."*

**For data mining use the following sources and data bases:**

Palestinian Chamber of Commerce
Union of Stone and Marble Industry
Then cross-check this data base with the name and addresses of all companies contained in the billing system of the Water and Electricity company by the relevant Municipality or Utility, using the last two bills.

**The target for each company is to obtain the following updated information:**

Name of the company
Location in terms of district or area
Phone number
Name of the owner Id Code for the Web Portal (N°)

| N° | INDUSTRY_NAME | ADDRESS | B_NO | STREET_NO | CODE_NEW | X_CENTROID | Y_CENTROID |
|---|---|---|---|---|---|---|---|
| 11 | Ar Rubae'eyyah for Marble & Stone Company | Industrial Ad | 59a | 380 | 380_59a | 160094,790 | 102054,020 |
| 14 | Fayez Gheith Stone Cutter | Industrial Ad | 61c | 380 | 522_7a | 160098,015 | 101955,980 |
| 21 | Ar Rahman for Marble & Stone Company | Industrial Ad | 13 | 522 | 522_13 | 160056,105 | 101869,960 |

**Palestinian coordination system**

| B_NO | STREET_NO | CODE_NEW | X_CENTROID | Y_CENTROID |
|---|---|---|---|---|
| 59a | 380 | 380_59a | 160094,790 | 102054,020 |
| 61c | 380 | 522_7a | 160098,015 | 101955,980 |
| 13 | 522 | 522_13 | 160056,105 | 101869,960 |

### 5.1.4 Step 4: The Evaluation Template

Furthermore the drawing up of a data evaluation sheet to combine all the data regarding location, using the Palestinian coordination system, with the environmental and social data, required for the purposes of the project is essential. We recommend you draw up the data evaluation sheet in such a way as to cross check a number of data categories through various controls.

Below is an **copy of the data sheet** we used to carry out the Hagar project evaluation:

MAP CODE :
PROJECT HAGAR EU LIFE THIRD COUNTRIES

INDUSTRY NAME
INDUSTRY TYPE
ADDRESS
TELEPHONE
ASSESS.DATE
WORKERS NUMBER
WORKING HOURS
NUMBER OF SHIFTS
OWNER
MACHINES AVAILABLE (MOD. AND TYPE)
WATER SOURCE*
DISCHARGE AREA
DISCHARGE FREQUENCY
WATER CONSUMPTION PER DAY
WATER DISCHARGED PER DAY
DISCHARGE TYPE
TREATMENT UNIT IN FACTORY
AVERAGE DISCHARGE
TREATMENT VERTICAL-SEDIMENTION
PLATE FRAME
COLLECTION
% OF DEBRIS
B NO
STREET NO
NEW MUNICIPAL CODE

### 5.1.5 Step 5: Assessment Plan & Data Analysis

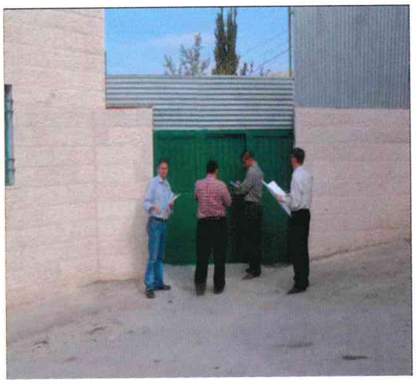
This action is the final part of the assessment. It is divided into two parts:

A. Assessment plan

B. Data Analysis

#### 5.1.5. A. Assessment Plan

For the implementation of this action we made use of the data base collected in the sub-task 5.1.3 (Data Mining). Furthermore we collected additional data during the field visits.
We recommend an expert team, to plan and carry out site visits to the companies listed in the data base.
The assessment records all data listed in the data evaluation sheet, geographical position via GPS and possibly photos.



#### 5.1.5. B. Data Analysis

This last part of the assessment was designed and carried out using cross-check methodology : the answers to the questions were cross-checked through various controls.

This step is of vital importance as many of the stakeholders fear that they may be revealing information which could be used against their interests, or in other cases people do not have the same level of 'scientific' awareness and may not be providing correct information because of a lack of experience. For these reasons the analysis grids need built-in internal checks.

Example : simply by asking the question "Does the factory have any sludge treatment units?" will often result in a positive answer. However, when the interviewer goes into more detail or asks to see what type of equipment is present (check on the name of the producer etc.),he discovers that in reality they don't treat the sludge, because they don't have vertical sedimentation and plate frames and the output of the so called 'treatment' is dumped in the surrounding environment.
In a similar way, there has to be an internal control for the water discharge and water consumption (cross checked also via water meters and data collected by the Water Companies/Municipalities ) as well as capacity and technical features of the machinery.

## The most important checks are exemplified below.

**WATER SOURCE***
Cross check with Municipal bills.

**DISCHARGE AREA**
Good faith (not one owner declared illegal dumping!)

**DISCHARGE FREQUENCY**
Good faith (impossible to monitor- but comparisons made between waste declared and no of discharges made)

**WATER CONSUMPTION PER DAY**
Cross check with Municipal bills and type of machines in factory.

**WATER DISCHARGED PER DAY**
All declared the same figure as entry indicating no recycling of water at present.

**DISCHARGE TYPE**
Nearly all declared slurry or sludge yet suspicions are raised here as the figures do not correspond (sludge in Italian terms is between 30 – 40% calcium carbonate – research shows that in Palestine it is probably at an average of 10%)

**TREATMENT UNIT IN FACTORY**
Visual check.

**AVERAGE DISCHARGE**
Average figures calculated on basis of declarations.

**TREATMENT**
Visual check.

**VERTICAL-SEDIMENTION**
visual check (use was also verified by testing the silo.

**PLATE FRAME**
Visual check.

**COLLECTION**
Good faith.

**% OF DEBRIS**
Good faith and local knowledge.

**MACHINES AVAILABLE** (MOD. AND TYPE)
Capacity of the machines compared with Discharge frequency and water consumption.

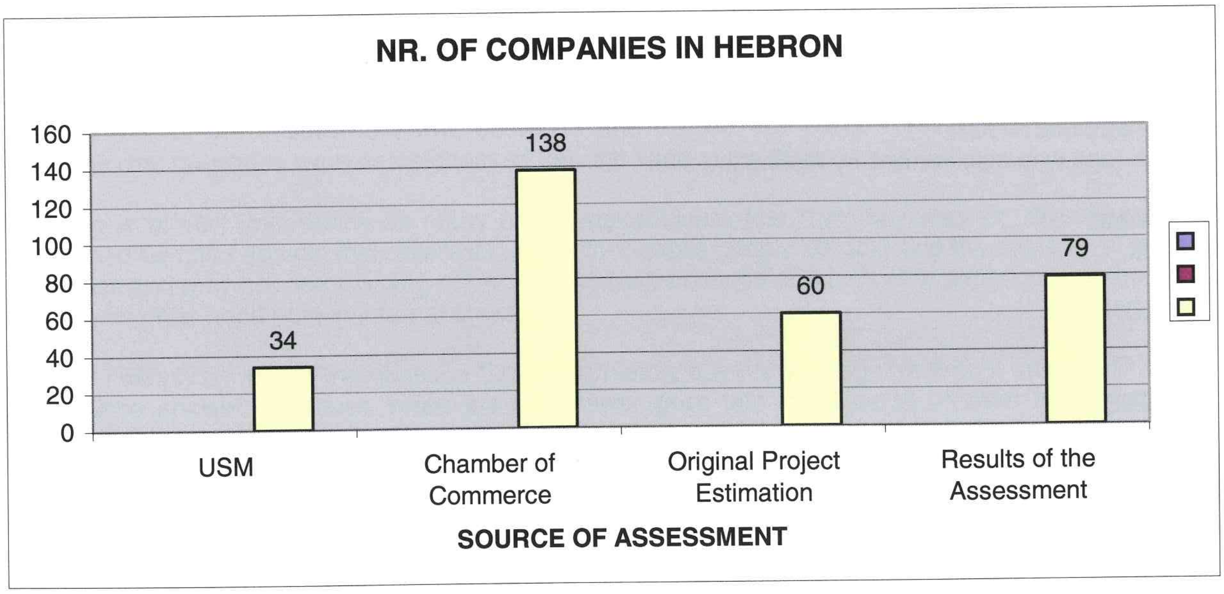
ANNEX 1:

**Assessment findings in the al-Fahs District**

The assessment was carried out through interviews and site visits to the companies, from the 10th of April 2006 through to the 24th of July 2006, with the support of the technical department of the Hebron Municipality for the management of the GIS equipment. The project architect, Arcangeli, was responsible for the technical coordination of the whole activity, using the GIS online, revising the data and transferring the information to the web team. The activity was carried out by the marble expert selected for this activity, Mr. Wael Hamed Mohammad Mugiaheed, with the support of the Municipality of Hebron and the coordination of Mr. Tawfiq Arafeh and his secretarial team. From 4 March 2006 to 09 March 2006 Mr. De Vita trained Mugiaheed in the correct use of interview techniques and how to ensure that as much information as possible was supplied during the interviews.

In the Hebron Area we identified 78 facilities for the cutting and polishing of stone and marble. However, not one single quarry exists within the territorial limits of the Hebron Municipality. In fact, the quarries that supply much of the raw material to the cutting and polishing facilities are located ONLY outside the municipal area, in the territory of Sa'ir, Shuyukh, etc.

This meant that the original estimations contained in the project (60 factories) was not correct. In our assessment we only counted factories, that is to say industrial activities, therefore excluding the commercial activities related to the marble industry, which were included in many other data collections (Chamber of Commerce, for example). This approach was chosen as the commercial enterprises have only a limited effect on the environment (small amounts of substandard products dumped as solid waste)



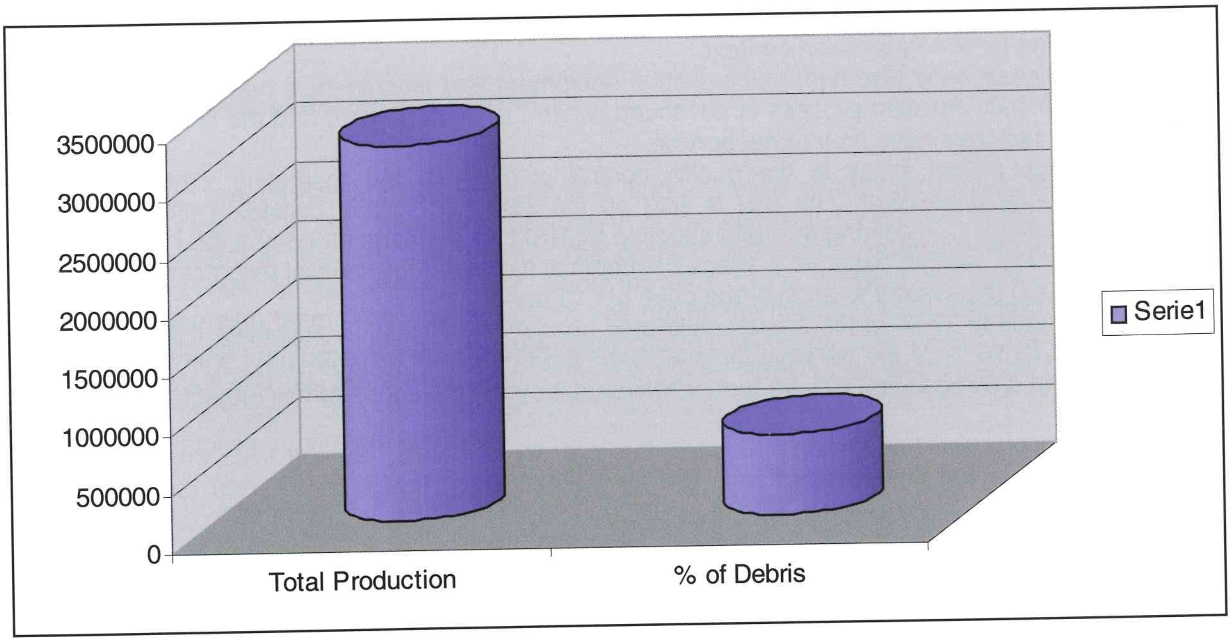
The companies employ 608 workers, corresponding to an average employment rate of 7,79 workers per factory, relatively high for the Palestinian context.
The level of industrialization is also high : all industrial equipment and machinery is made in Italy, Germany or Turkey and the industrialization process is advanced, while the management and the level of ICT is low. For example, many factories have no Internet service.
Industrially there are critical areas in the quality control, packaging and marketing. Only 20% of the companies export their production. The rest is sold on the domestic market (including Israel, the major customer of the industry). Considering the data supplied by USM as a means for comparison emerging from the declared production, we can estimate a yearly commercial turnover (commercial value of the production) of around €57.600.000 (equivalent to an average price of €18 per $m^2$.
This figure corresponds to 17 % of the annual estimated turnover for Palestine. However, it is interesting to note that we cover 13,16 % of the national factories with a production that represents 20% of the national total. These apparent discrepancies require further research, beyond the scope of this project.

The industrialization process has strongly reduced the quantity of debris, derived from the cutting of the blocks. The total production is estimated by USM as 3.200.000 $m^2$ (equal to 320.000 tonnes) and the average debris generation today reaches a total of 688.000 square meters, 21,5% of the total, compared to 15.5% in Italy. The declarations of those interviewed regarding this point seem to be very realistic, because this percentage has a direct impact on the final cost of production, cost of the block, prices and sales and thus directly affects the profit margins of the factory owner.

This data is approximately half of the original project estimation (110.000 tonnes/year). That is to say, that more than 20% of all raw blocks that enter a factory is lost during the cutting process and the debris thus generated requires dumping in different locations, always in 'open space' with relatively easy access, as assessed by the data collectors. The problem in Palestine is that this debris has no commercial value when it is dumped and thrown into the surrounding environment, whilst in Italy, to continue the previous comparison, the debris is treated and recycled for use as vital sub-products (mosaics, derived products like crushed calcium carbonate, hard core for roads and the construction trade, etc.).

Recently a parallel market has been launched in Palestine for this kind of product (in the picture a stone wall made out of marble debris on the side of a public road,) thanks to the establishment of a number of crushing plants.

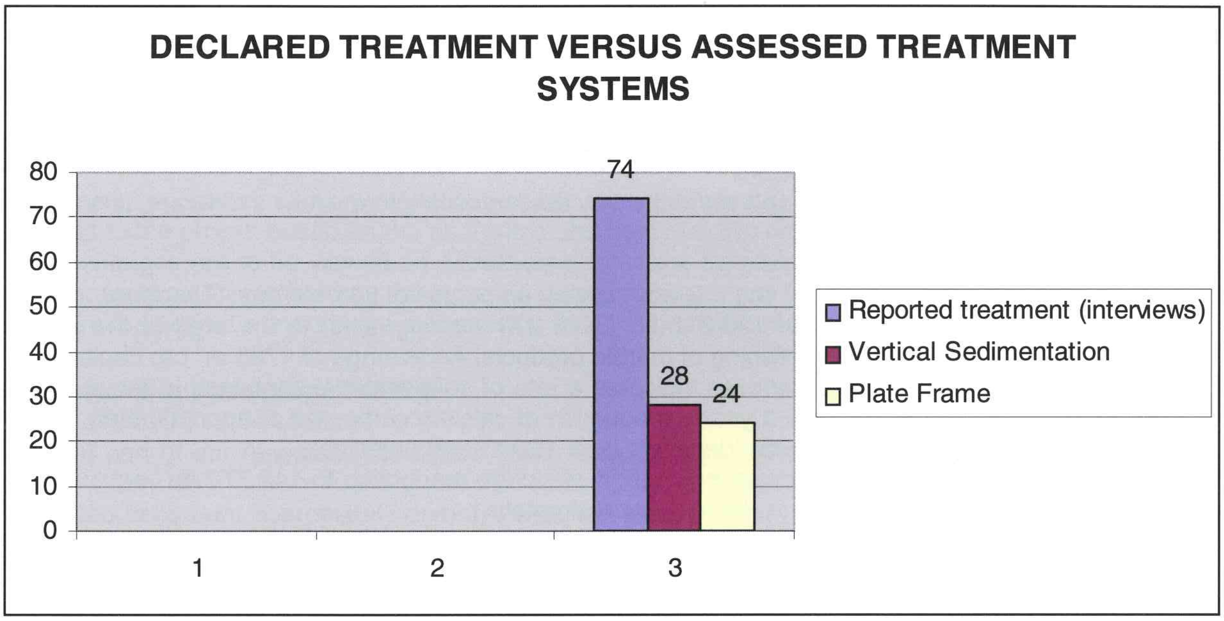
During our activity in Hebron we established the existence of 5 crushers, two of them with a high level of industrialization. In the video we documented one of these activities, where it should be noted we were able to witness for ourselves the use of child labour. If the process of reconstruction in Palestine is to begin, we are sure that the majority of this debris could also be recycled in products for civil engineering projects, relieving the environment of this devasting burden. This will be dependent on the creation of an adequate logistic process to be designed and sustained by International donors.




The problem of debris remains relatively high outside Hebron, in the quarries, where more that 60% of the excavated material extracted is considered to be debris of no commercial value. It is this quantity that causes the most serious damage to the Palestinian landscape
Another important element emerging from the assessment is that 74 of the factories surveyed declared owning some form of treatment system for the sludge, a percentage higher than 94 % of the total. Actually,this information is rather misleading, because the concept of 'treatment system' is somewhat open to interpretation. For example, the data collectors recorded positive response even in presence of so called 'drying systems' (a hole in the land where the company throw the humid sludge and wait for it to dry due to the seepage of the water content into the surrounding land, until the next discharge).
In order to understand the real situation in the field we have to compare this 'Yes' with the number of vertical sedimentation systems reported (28 = 35,89% of the total) and with the so called 'plate frame system' (23 = 29,48%).

The question regarding the location of discharging areas for 'treated' waste is interesting, 100% of the people interviewed answered 'open areas' (to be interpreted as the dumping of waste in open areas).

Comparing and cross checking this data we obtain a picture of the industry in Hebron: less than 30% of the companies have a 'real' treatment system even though, 100% of the companies discharge the liquid or humid material into the surrounding environment.

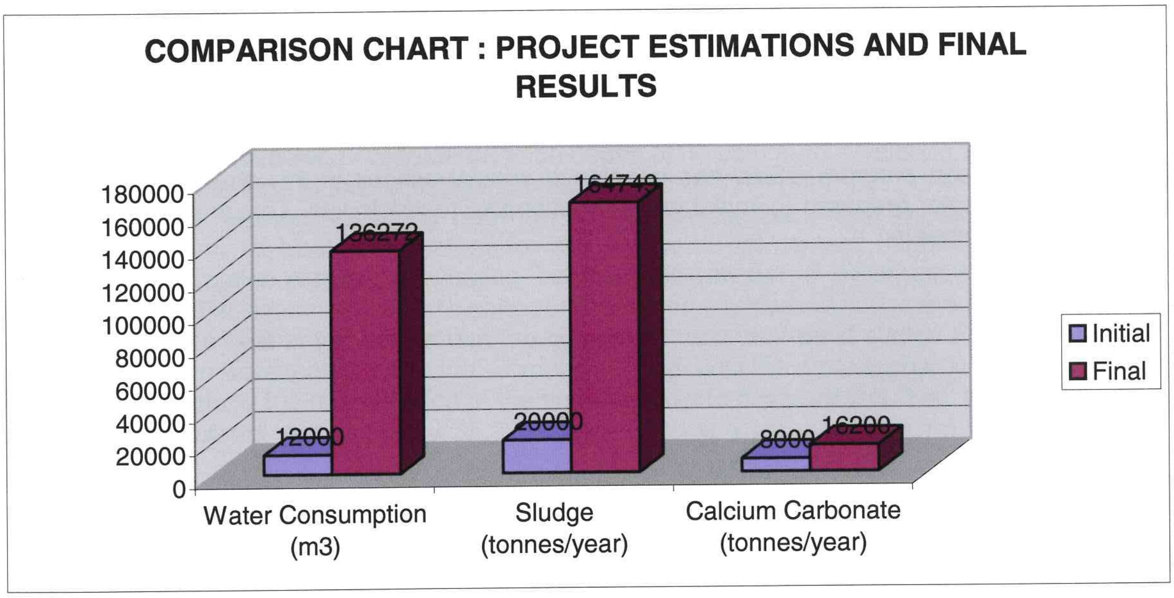



Until now only the American program USaid has developed special actions in this direction, co-financing elements of the private sector prepared to invest in eco-sustainable technologies. This may be an example to follow for future developments.

## 8 – Sludge Production and water consumption

The major contribution of the assessment to the project is the calculation of the yearly water consumption and sludge production.
The values contained in the initial estimates of the project (20.000 tons/year of sludge and 12.000 tons/year of water) are actually far below the real picture
The data emerging from the assessment and elaborated by the technical group show a different, unexpected picture:

1. The daily water consumption of the 79 companies amounts to 501 $m^3$/day. Therefore we can estimate a yearly consumption of 136.272 $m^3$ (50 x 272 working days) in the area of the Hebron Municipality for the cutting and polishing of marble products. An average of 1725 $m^3$ pro capita.
2. The chemical analysis of the 9 samples indicates a rate of solid material contained in the sludge of approximately 9%. Thus we have a yearly production of calcium carbonate of approximately 13.500 $m^3$, equivalent to 16.200 tonnes/year (density 1,2 for 100 micron particles).
3. Therefore we can calculate an annual production of sludge amounting to 149.772 $m^3$ equivalent to approximately 164.749 tonnes/year (density approximately 1,1).




These numbers substantially change the framework of the project, putting the focus of the activity even more strongly on water recycling, as opposed to the possibility of the recycling of calcium carbonate.

In the light of the above mentioned analysis, resulting from the territorial assessment, we can now estimate a yearly water recycling of approximately 300 $m^3$ per day (= 60% of the total daily water consumption), for a yearly recycling of more than 81.000 $m^3$ / year, instead of the initial estimation of 12.000 cubic meters.
This will require changes to the initial ideas regarding the distribution of infrastructure and we draw the attention of the project designers and Board of Directors to the fact that all 79 assessed companies currently use water supplied via tankers, in addition to the pipe network, for their water supply. That is to say, it may be worth analyzing the opportunity and value of designing a larger prototype capable of recycling up to 300 $m^3$ per day and an adjustment in the distribution network that was originally planned, based on the present tanker delivery system provided by private companies.

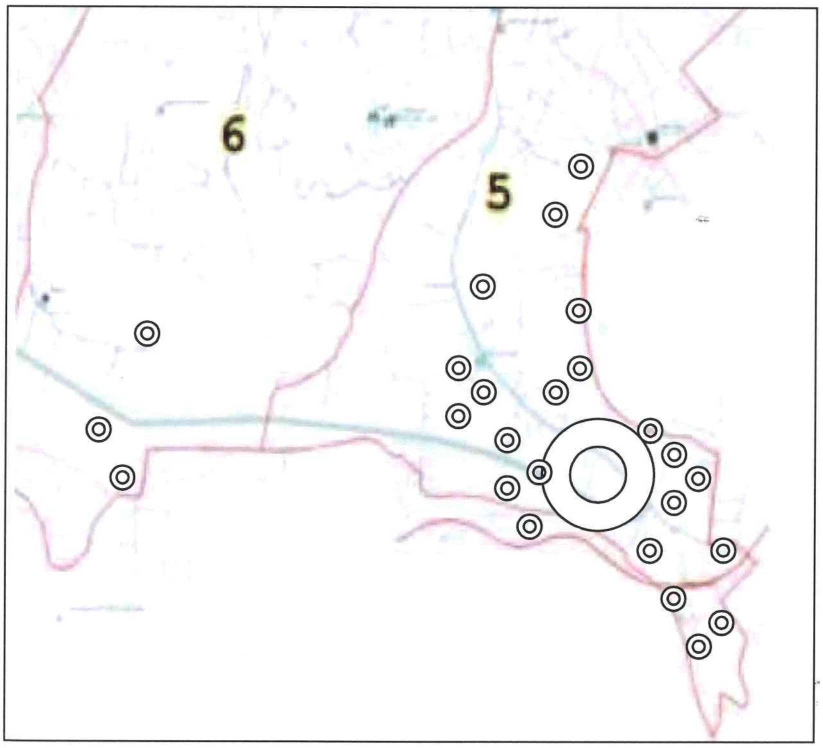
**The principal reasons for this are:**

- A piped distribution capable of dealing with the above amounts would be very costly
- All factories make some use of tankers and possess water cisterns
- This activity would ensure year round instead of seasonal work for transport firms and individuals

Therefore, the Bod should now meet to assess this recommendation and consider making the necessary changes to the project based on the analysis of the data that this assessment has provided.
These changes are to be viewed as extremely positive as they are due to the fact that much more water is being consumed and wasted by the industry in the Municipality of Hebron than was originally estimated and therefore the project's importance in improving the sustainability of the industry has increased.

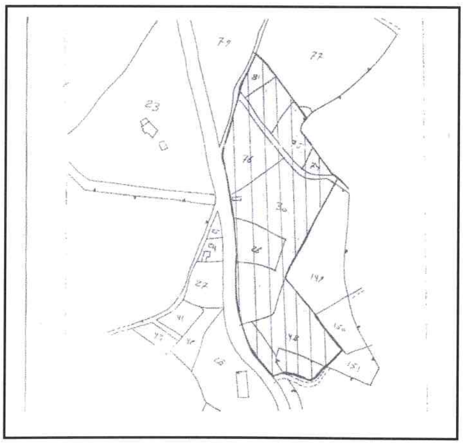
**III – Facts about dumping of sludge**

The last part of our research was aimed at the identification of the dumping areas. 100% of the interviews offered a very clear answer to the question : 'open areas', that is to say surrounding environment.
The video document appropiately demonstrates this phenomenon, which is, in actual fact, repeated across the whole of the Hebron Municipality, particularly in districts 5 and 6.




In the 5th district, the area comprises among the cadastral plots 81 to 48 is a major dumping area, where all local manufacturers discharge their sludge and debris.

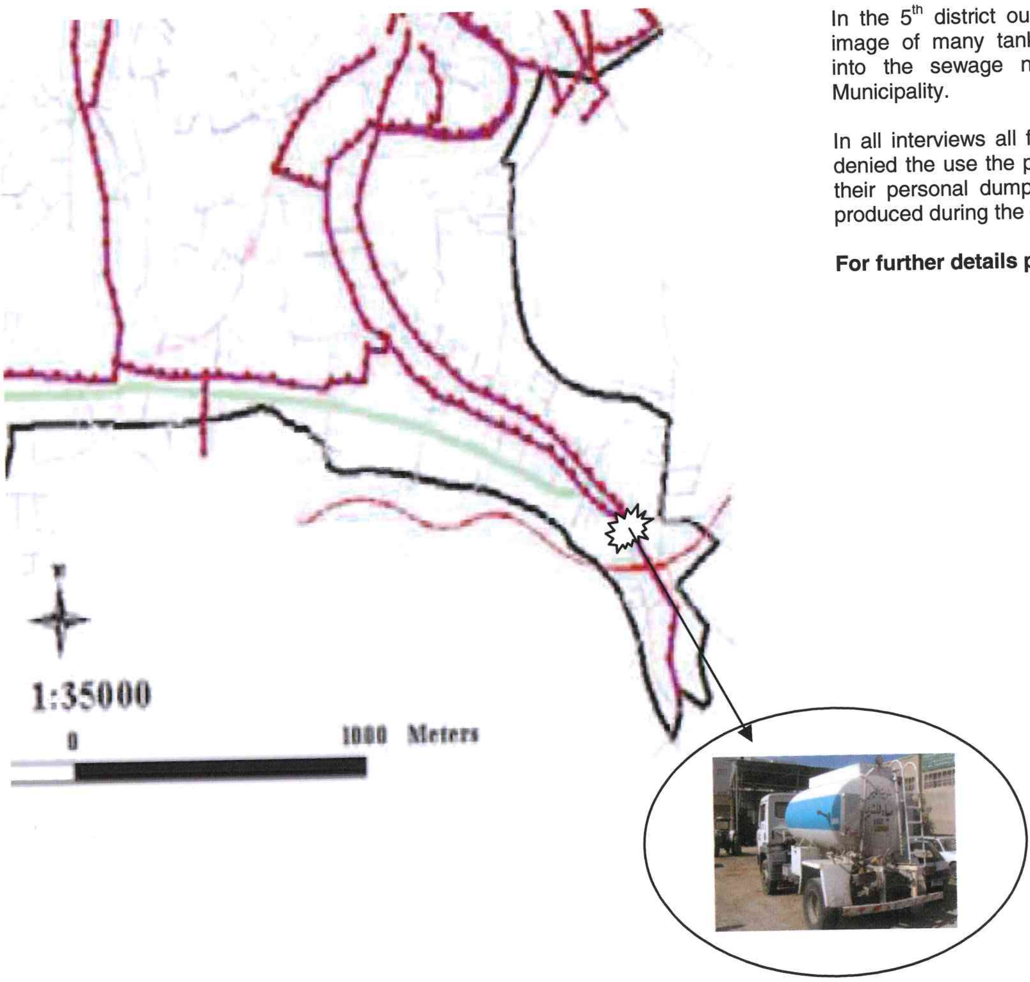
We have selected this area as location for the building of our prototype.



Scanned map of the area

In the video we visually document many different sites, in different locations, used as dumping areas by the marble factories.

But what we discovered during the assessment is that the major dumping channel for the liquid sludge (and even the pre-treated liquid waste products of cutting activities) **is the public sewerage network**. This job is carried out by private companies or individuals who remove the waste from the factories using tankers which they then discharge into the public sewerage system.




In the 5th district our video crew filmed the image of many tankers discharging sludge into the sewage network of the Hebron Municipality.

In all interviews all factory owners until now denied the use the public sewage system as their personal dumping area for the sludge produced during the cutting activities.

**For further details please view Video V1**

In one single day of video recording spent along the sewerage network in the 5th district we counted 12 trucks discharging sludge into the roadside drains, after having removed the stone drain covers. This is an illegal, yet tolerated activity.

This is a major environmental problem because the solid part of the sludge deposits quickly and the lack of sufficient rain to carry it further down the system results in blockages that cause economic damage to the municipality as well as generating health problems associated with stagnant water.

## 6. STAGE 2
## How to design a sustainable plant for the recycling of the marble waste

**Description of the activity**

The objective of this activity is to design guidelines and procedures for the definition of the most appropriate size of pilot plants at cluster level, which can recycle sludge (water and calcium carbonate) and debris generated by the marble industry, transforming, after appropriate treatment, the sludge of the marble production into water and calcium carbonate to be sold for varying uses on a number of markets.

**Problems encountered**

Firstly, major critical points of this activity, besides the implementation of proper logistics, are those related to the need for graduating a specific technology, with capacities, pressures, electrical power, and disposal capacity appropriate to diverse material inputs as shown by the project assessment and the related chemical analysis. In other words, the major technical problem stems from the fact that in a cluster system the material inputs originate from extremely diversified productive processes, either for quantity, density, typology, specific material, treatment method or location, with more need for space, distribution systems and volumes compared to basic corporate models having their settling plants depending on actual needs.

Secondly, sustainability of such a plant depends on the scale economy, which is the result of a number of combined factors:

- local regulations
- type and quantity of waste produced and recycled
- selected technology/processing
- related logistic and utility model
-

**Best Practices for Technical Design**

**6.1.1: Step 1 The 3 Preliminary Elements**

In order for us to carry out correct design and effective implementation of the plant, we must clearly define the following three preliminary key elements:

1. What kind of products/applications/services are we projecting for the marble waste, after appropriate treatment?

2. What kind of processing and/or technology are we designing for the building of the plant?

3. What is the level of sustainability for such a utility service? (considering the utility model and the local regulations concerned as well )

**6.1.2: Step 2 The Recycling Process**

There are two basic products/services, which we can recover from the marble waste:

a. Recycled Water.
b. Dehydrated Calcium Carbonate.

In this guidance document we do not discuss the very high potentiality of the abandoned marble quarries, which can be reused as landfills for municipal solid waste. This may be the object of a further specific project, which we strongly recommend to integrate the recycling circle and offer high benefits to the Palestinian population.

From the experience gained in the "Hagar" project, we recommend focusing on these first two products, because:

- recycled water and calcium carbonate are products generated by the same processing plant, thus minimizing the costs;
- water is a scarce and strategic product in Palestine;
- calcium carbonate is a very flexible by-product, and can be used in several applications with a high market demand.

**a.1** In order to assess the water quality we recommend using EU-Standards. The experience gained in the project 'Hagar' showed that the Italian law (D.Lgs. 31/2001) can be a reference model. However we stress the need to standardize these procedures, at national level in order to avoid misuses and environmental damage caused by inappropriate recycled water. This question is very important if we consider the current debate at EU-Level on 'inert' and 'special waste produced by inert processing'.
The analysis carried out on the recovered water in Hebron showed a composition suitable for industrial use and therefore this recycled water can be sold to the marble companies for cooling purposes in the cutting and polishing processes, thus replacing the drinkable water supplied by the Municipality for industrial uses.

For eventual agricultural use the water needs an additional treatment, which is not part of this guidance document. This could be the object of a specific project, considering the water need in Palestine for the agricultural sector and the relatively low costs required by the additional treatment, to obtain high quality water for irrigation.

From our experience in al-Fahs area, the sludge/water ratio is between 90% and 95%, which is much more than originally expected. This depends on the fact that there is a lack of corporate treatment plants and the quality of the sedimentation tanks (which, if available, are the most common treatment systems ) used among the Palestinian companies, are very old and often locally made, and with a low working efficiency.
However, we strongly recommend carrying out preliminary analysis on the sludge before starting to plan a utility, to estimate in advance the projected sludge/water ratio, which is an essential component in the success of the project.

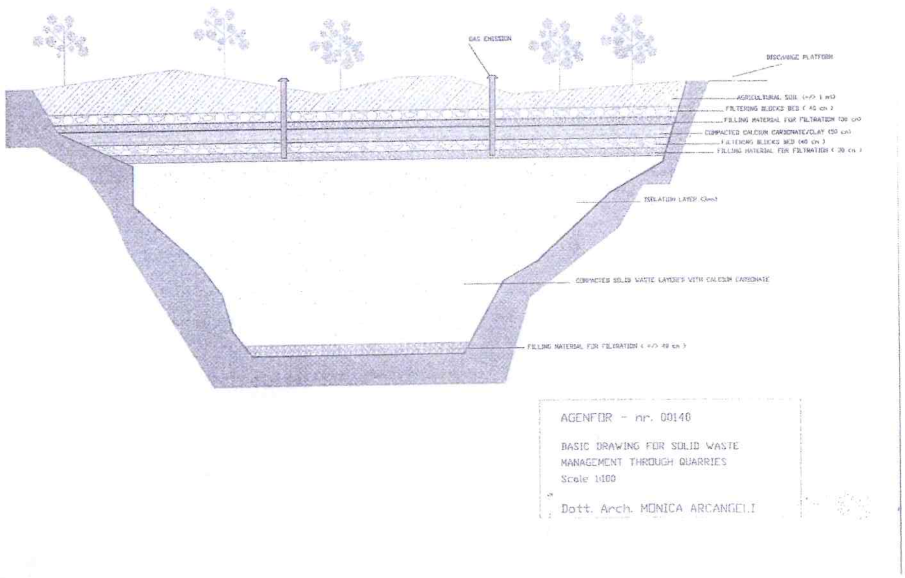
**b.1** The composition of the stone in Palestine and its processing is very interesting from a commercial point of view. Actually the entire supply-chain is based on a nonfoliated metamorphic rock resulting from the metamorphism of limestone, the so-called Jerusalem Stone.

Contrary to other production regions, such as Italy, where the cutting process mixes limestone with other materials (granites, etc.), containing amounts of silica in the form of chert or flint, as well as varying amounts of clay, silt and sand as disseminations or nodules, the sludge produced in Palestine is mostly a pure mixture of water and calcite, which is a crystalline form of calcium carbonate ($CaCO_3$).
After the dehydration process of the sludge, we therefore obtain a high quality calcium carbonate, in the form of powder, differing in size between <10 and >100 micron. Contrary to other advanced marble processing clusters, the percentage of chemical additives (such as abrasives) is relatively low, certainly far below values set by EU-Regulations.
The final results are products which offer several industrial applications.

Within the framework of the Hagar project a treatment plant for the recycling of industrial water has been designed and built, through which the Municipality recover around 95% water from the sludge. Thus, part of the processing cycle, represented by 5%-10% micronized stone powder, with a humidity component of 9-12%, remains without treatment and is dumped into the municipal landfill as inert waste.

In the future we strongly we recommend developing integrated platforms, capable of recycling both, water and calcium carbonate, recovering water for local industrial use and parallel producing different CaC03-based-products, such as lime, paints, industrial fillers, non-conductors- and insulating sheaths, etc.. This integration process will also offer a real economy scale, which is the key factor for a successful sustainability of the utility.

CaC03 micronized powder as well as crashed debris can also be used as layering systems for the re-use of abandoned quarries, to be transformed in landfill for municipal solid waste.
In the project Hagar we developed a potential application, as follows:



**In Annex 2 "PALESTINIAN QUARRIES: RESTORATION AND AFTERUSE"**

**6.1.3 Step 3: The Technology**

The best methods determined to be the most effective, for preventing or reducing pollution generated by the marble industry, are those aimed at recovering water and Calcium Carbonate thanks to a double-cycle-technology, which integrates press filtering processes with vertical sedimentation and clearing technology.

The experience gained in Hebron recommends a logistic platform constituted by two different stages of sludge treatment, through different phases of water clearance and CaCO3 dehydration.
By means of a ramp linked to the main road, tankers arrive at the unloading area. From that elevated point, they unload into 2 different 62.540-liters containers, equipped with two automatic scrapers and mixers. Then, mixed sludge moves to another 10.000-dmc container, equipped with shaker for permanent homogenization and stabilization, from which slurry is channelled into 2 filter presses thanks to centrifugal pumps and finally pressed and dehydrated.
At this point, the output is made of dry residuals, with a humidity level of approximately 10%, and water, which is channelled through the parallel clearing plant, where rain water is collected too.

From this pit, thanks to a stem pump, water is channelled into a 30.000-liter sedimention unit where the needed quantity of flocculent solution, taken from a proper container for the necessary dosage, will be added to facilitate the deposit of particles in suspension. From the sedimention unit either clean water is shifted from the surface into the 30.000-liter cleaning water reservoirs and then be loaded into departing tankers, or slurry, deposited on bottom of the sedimention unit, will be removed and channelled once more into the homogenization reservoirs before moving back to the filter press.

We recommend establishing the size of the plant, in terms of recycling capacity, in accordance with the data emerging from the territorial assessment. In order to determine the recycling capacity of the plant the storage capacity of the 4 main tanks and the characteristics of the press filters must be considered:

Collection tanks + sedimentation tank + storage=100% capacity

A second calculation should be made to determine the size and type of the presses, which should be able to operate with a high degree of production flexibility. We introduced a PLC controlled press filtering system, in order to enable the operators to change parameters via software and offer the necessary flexibility to the production cycle.

*"The filter press with plates has been projected and realized for a completely automatic operating without the help of man.*
*This has been obtained by inserting an electronic controller inside the electrical consol, which must respect all stages of the filtration process in a prearranged sequence, through a fixed program stored in the central storage of the controller. What is more, this controller can stop the working of the machine, adjusting possible irregular situations through special sensors.*
*The management system of the mud dehydration plant is designed to maximize the quality of the results.*
*In fact, in addition to the installed PLC, we also foresaw an interface monitor thanks to which it is possible for anybody, if qualified, to modify every operating parameter of the filter or of the plant in order to adapt it and set it to more specific needs. For example, for the runnubg of the programme, it is possible to read though the working status of the plant and every possible anomaly on the "alarm list"on the different pages on the monitor, It is possible to set operating time according to different day shifts and different days during the week; fixing the automatic start/stop of the filter press after an established number of executed filtering cycles, checking the pressing time and the operating time of each component in view of a possible planned maintenance.*

*The discharged mud is stocked into a tank complete with mixer (so there is always the same mud concentration).*
*By means of a centrifugal pump this mud is taken from the stocking tank and pumped into the filter, where it is dehydrated.*
*During this stage, the mud passes through a hole which is present in each plate, filling the formation panel spaces.*
*Then, with the help of the pump, the value of the inner plates pressure rises, and at the same time, the water in the mud (filtered by cloths) comes out. Then this water is collected and sent to the discharge by little basins placed on the extremity of the plates. Plates are in contact with each other by the push exercised by a piston, which is driven by a gearbox of oleodynamic pressure.*
*When a fixed pressure is reached the value inside the plates is kept constant for a fixed time at the end of which the working pump stops.*

*Through an automatic control, driven by a logic schedule, the translation of the contrast piston runs until the dead bottom point is reached and during this movement plates open and discharge panels of dried mud (the fall of panels is helped by a mixer which shakes plates with a number of fixed blows ).*
*A second movement of the piston up to the dead top point closes the plates again, allowing a new cycle to begin. Panels of dried mud are gathered in a tank placed under the support of the filter ready to be transported."*

(Excerpt from 'Technical Report', pg. 11-12)

A very important recommendation, stemming from the practical experience gained within the project 'Hagar' is to add a very capacious storage system to the entire recycling process, able to absorb at least 5 days water production, in order to overcome potential production crisis. Contrary to standard corporate plants, in cluster-based systems there is a difference between the projected capacity of the plant and its real operative production, because the entire production cycle depends on several external factors such as water demand, closure by Israel etc..

Therefore the water distribution should consider a storage capacity, in addition to the just in time network.

### 6.1.4 Step 4: Organizational Chart and Feasibility Study

The best methods determined to be the most effective, for preventing or reducing pollution generated by the marble industry, are the following:

1- Develop an operational model in line with the feasibility study.

2- Introduce a Local Regulation as legal framework for the activities of the utility.

#### 6.1.4. A. Operational model

Considering the quantity assessed and the technology selected, we recommend developing an operational model, which supplies the basis for the feasibility study and the plant implementation.

In ANNEX 3 to these Guidelines, we provide the Manual eleborated by the Municipality, as a guidance for further activities.

However we recommend the development of whatever operational model is in accordance with the general governance of the plant, to minimize costs. In the case of the Hebron facility, this governance up-to-date foresaw that the Municipality directly managed the plant, therefore several tasks were directly assigned to specific departments of the Municipality (mainly Water Dept), which utilized its own means, human resources and procedures, to deliver the services.
This is the reason why we have limited the number of workers and staff employed by the utility to 8 persons:

- One electrician (part-time)
- Two mechanical technicians ( part-time)
- One supervisor (engineer)
- Two financial employees (1 full time and 1 part-time)
- Two workers (full time)

Another Best Practices stemming from 'Hagar' Project is that the personnel employed by the Municipality must be trained in order to run the plant properly and consequently carry out the duties assigned.

To this end we promoted a training profile, which can be considered as a Best Practice tip in the field.

The specific course covers three areas of competence:
basic, crossroad and technical competences, for a total of **400 hrs**.

**Basic Competences**

ECDL and Management of the LMS **80 Hrs**
English and Technical language **64 Hrs**
Assesing and managing envirinmental change **40 Hrs**
Occupational hygiene risk and human health with gender issues moduls **24 Hrs**

**Technical Competences**

Theory **60 Hrs**
Applied Technology **132 Hrs**

We underline the urgency to set a chart of competences in this field and to sign MoUs with the International training centres specialized in the field, in order to reach a high degree of recognized competence, know how and ability

### 6.1.4.B. Local Regulation

The Local Regulation represents the legal framework for the implementation of the plant. Due to the extreme difficulties in enforcing law in Hebron (and in Palestine in general) we recommend adopting a win-win strategy based on grassroots politics and awareness arousing among local horizontal and vertical stakeholders.

As general principle for the definition of Best Practices in the field of Marble Waste we suggest:

**1-** Incorporate costs of transportation, treatment and recovered water into one single voice.
This is because, in some cases ,companies are not accustomed to paying water bills (usually issued by Public Authorities) but they are familiar with the payment of water transported in tankers. Therefore it is better to structure a single price, which includes the cost of the freight services (collection of sludge, treatment and re-distribution of recovered water) and the cost of the water.
**2-** Set a water price below the actual price used by the local authorities for drinkable water.
Actually the water consumed by the marble factories in Hebron is taken directly from drinkable water, which is scarce. As a result of this scarcity, the Municipality is forced to interrupt the delivery service to the al-Fahs area for 7 days a month in Winter and for 10 days a Month in Summer.

The price for the water supplied via pipelines is >4,5 sh./m3.. To this are added freight costs for both, water delivery and sludge removal. Each transport (with tankers of 10-15 m3) costs between $18 and $22. There is no current estimation for dumping, because at the moment the sludge is unloaded into the public sewage.

Considering this, the price determined by the utility for the recovered water is 3,5 sh/m3. and this includes all costs. In this way the companies can consider the deal as very convenient and deliver sludge to the utility and not to the illegal dumpers.

**3-** Establish a water balance, decreasing the supply of drinkable water to the marble companies for the same quantity of recycled water available after treatment. This will make more drinkable water available for the population and 'force' companies to buy the utility services, thus granting sustainability and environmental friendly attitudes.

**6.1.4.C. Feasibility Study considering:**

a. The legal Framework
b. The selected technology and the related costs
c. The organizational model
d. The quantities of recovered water and calcium carbonate available

We need to design the feasibility study, as mandatory task for the decision to build such a plant at cluster level.

The following assumptions offer the basis for the :

**1. Revenues**

- The production capacity/year of the prototype must be calculated on the quantity set by the assessment.
- We must also consider: the level of humidity of the pressed sludge and the fact that 8-10% of the companies will bring sludge with a low level of water (time of collection, pre-treatments, ecc.) to the prototype.
- The estimation of the collection capacity based on the distribution system available (pipes and/or tankers).
- Sale price of the water considering the constraints represented by the law enforcement.

**2. Costs**

We do not need to include the pay off of the investment for the prototype in the calculation, because this is supposed to be funded by donor grants.

Labour costs must be calculated at actual Palestinian salaries, depending upon the governance model available.

Given this framework, we recommend building integrated plants, capable of recovering water and calcium carbonate, because the BEP for water recovery is at a threshold of >300 m3 water/day. Contrary to current opinion and despite the investment cost, a Calcium Carbonate recycling plant, with a capacity of 80.000 kg/day, can generate a gross profit of € 328.530,00/year.

In ANNEX 4 the related feasibility Studies.

**ANNEX 2 PALESTINIAN QUARRIES: RESTORATION AND AFTERUSE**

**Background**

In Palestine there are approximately 300 marble quarries, most of them located in four Governorates: Hebron, Bethlehem, Ramallah (Bir Zeit) and Nablus. In the majority of the cases the quarries are privately owned. We estimate that 65% of the existing quarries are not in use or semi abandoned for technical and financial reasons. Quarrying and related value added activities result in a number of waste streams . Marble processing companies have a very high impact on environment and public health, as described in the project HAGAR, funded by the EU_Commission under Life Third Countries.
The management of waste within quarries is not regulated in Palestine therefore old quarries usually remain in open air, without afteruse, with free access and are not safe. The Palestinian Authorities ought to tackle the issue of safety in the very near future by providing improved security measures around site boundaries and entrances (fence, etc.).

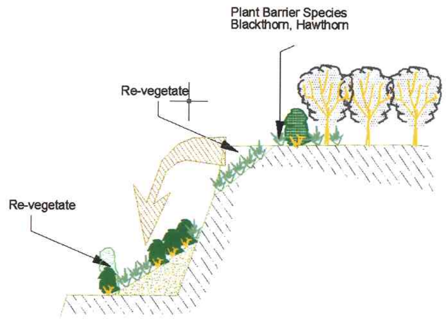
In this note we only consider two aspects of the quarrying activities, which should be dealt with by local authorities, transforming problems into opportunities:

- Afteruse of the quarries for CD material with related Land Reclamation and
- Afteruse of the quarries as landfill for solid waste and related Land Reclamation

1- LANDSCAPE, RESTORATION & AFTERUSE

Landscape change and visual intrusion are one of the key environmental issues associated with quarry developments. Because of the diversity of local landscapes, the potential impacts vary considerably in natural surroundings The method of extraction and associated restoration scheme, where properly planned and implemented, can eliminate and / or minimise these potential impacts.
Here is some useful information on the principles of restoration and on issues such as soil handling and afteruse options.

## 1.1 Environmental Management Guidelines




Face Treatment on upper bench

**Minimise impact on the landscape through proper planning and design:**

Direction of working and phasing of extraction.
Implement progressive restoration, where possible.
Location of processing plant and stockpiles.
Use of screening bunds.
Use of pre-planting, where possible, to minimise the impact of future phases of extraction.
Operational landscaping around site perimeter and at site entrance, where appropriate.
Suitable choice of colours / finishes for plant and buildings
Retain and / or reinstatement of boundaries and boundary features where practical.
Use of directional lighting, as appropriate during hours of darkness.

### 1.2 Restoration and Afteruse:

- Consider and develop a restoration scheme at the earliest possible stage in the planning of quarry developments.

- Consult with interested parties regarding afteruse/restoration options.

- There are a number of afteruses to be considered, including: agricultural, forestry, amenity, natural habitat, waste disposal, etc.

- Implement progressive restoration, where possible.

- Maximise soil recovery during stripping operations, and store topsoil and overburden materials separately.

- Retain topsoil and overburden to ensure the materials can be re-used in restoration.

- Provide an appropriate programme of maintenance and aftercare.

**Result of this activity will be:**

- Elimination and minimisation in the production of waste, such as sludge and debris.

- Re-use and recycling of unsuitable materials (such as poor quality rock arising from dimension stone quarries, and clay / silt materials arising from settlement processes)

- Re-use and recycling of rejected products from block making, concrete and asphalt / tarmacadam production operations.

- Ensure appropriate disposal of excess / unused explosives, in accordance with the manufacturers guidelines and health & safety regulations (if available).

- Use designated storage areas for particular waste types and 'authorised' waste contractors for the collection, re-use and disposal of waste oils, batteries, tyres, domestic waste and scrap metal (in compliance with current waste management legislation)

- No burning, disposal or mixing of waste materials, or use of waste materials in boilers should take place without prior consent of the local authority.

- Appropriate security and signs around entrance(s) and boundaries to deter and prevent illegal fly-tipping of waste materials by third parties.

## 2- SOLID WASTE MANAGEMENT THROUGH QUARRIES AFTERUSE

When quarries close down, the quarrying area must undergo rehabilitation. One of the easiest solutions is to integrate this rehabilitation process with solid waste management.

**This solution is technically feasible and economically affordable.**

Technically, waste dumps are contoured to flatten them out, to further stabilise them. To stabilize the chemical processes and avoid acid mine drainage, the quarry is then generally covered with a number of drainage and isolation layers, including top soil, and vegetation is planted to help consolidate the material.
The construction of a landfill within the framework of an abandoned quarry requires a staged approach. To be commercially and environmentally viable, a landfill must be constructed in accordance with specific requirements, which are related to:

- Location
- Easy access to transport by road
- Transfer stations if a rail network is preferred
- Land value
- Cost of meeting government requirements, such as the EQA in Palestine
- Location of community served (A good scale is probably JSC)
- Stability
- Underlying geology
- Nearby earthquake faults
- Water table
- Location of nearby water reservoirs, streams, and flood plains
- Capacity
- The available void space must be calculated by comparing it to the landform with a proposed restoration profile.
- This calulation of capacity is based on the Density of the wastes, amount of intermediate and daily cover, amount of settlement that the waste will undergo following tipping, thickness of capping and construction of lining and drainage layers.

**Protection of soil and water through:**
Installation of liner and collection systems.
Storm water control
Leachate management.
Landfill gas management (offgassing of methane generated by decaying organic wastes)

- Nuisances and hazard management.
- Costs
- Feasibility studies
- Site after care
- Site investigations (costs involved may make small sites uneconomical)

**Typically, in non hazardous waste landfills, in order to meet predefined specifications, techniques are applied by which the wastes are:**
- Confined to as small an area as possible.
- Compacted to reduce their volume.
- Covered (usually daily) with layers of soil.

During landfill operations the waste collection vehicles are weighed at a weigh-bridge on arrival and their load is inspected for wastes that do not accord with the landfill's waste acceptance criteria after which the waste collection vehicles use the existing road network to the tipping face or working front where they unload their load (Platform). After loads are deposited, compactors or dozers are used to spread and compact the waste on the working face. Before leaving the landfill boundaries, the waste collection vehicles pass through the wheel cleaning facility. If necessary, they return to the weighbridge to be weighed without their load. Through the weighing process, the daily incoming waste tonnage can be calculated and listed in databases.
Typically, in the working phase, the compacted waste is covered with carcium carbonate produced daily by the marble processing factories. The space that is occupied daily by the compacted waste and the cover material is called daily cell. Waste compaction is critical in extending the landfill life. Factors such as waste compressibility, waste layer thickness and the number of passes of the compactor over the waste affect the waste densities.
The dumps are usually fenced off to prevent livestock denuding them of vegetation. The open pit is then surrounded with a fence, to prevent access, and is generally eventually filled up with ground water.

**3- Potential Applications in Hebron**

This is an integrated process to manage the disposal of sludge and debris produced by the marble processing companies in Hebron, by rehabilitating old quarries and regenerating agricultural soil.

**The basic components of this process are:**

1. Identification of suitable quarries with a proper logistic for the connection to the marble processing facilities. several locations between Beit Fajjar and Al-Arrub areas cab be identified.

2. The preparation of the Quarries, considering the following elements :

   A- Geological characteristics of the quarry.
   B- Logistic and accessibility.
   C- Logistic for the crushing / mixing plant and the storage.

**The entire process for the rehabilitation of quarries consists in the following 5 sub-processes:**

1. Filtration layer by crushing debris. Size of the filling material between 5 to 10 cm.

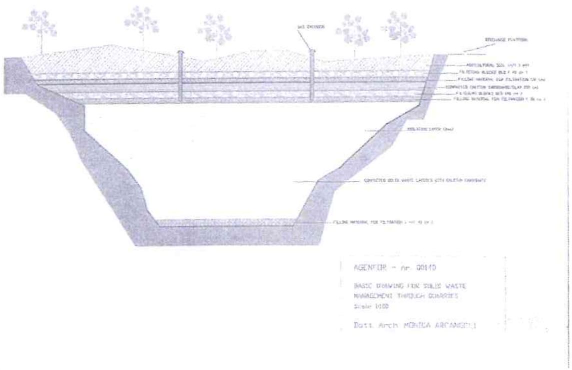
2. Block platforms, to stabilize the filtration layer and convoy percolated water. Re-use of debris.

3. isolation membrane to grant isolation of the system by keeping natural permeability, water convoying and protection from eventual internal or external pollution processes. This is essential because in the past explosives have been used for mining activities and this may have caused crushes in the geological layering of the abandoned quarries.

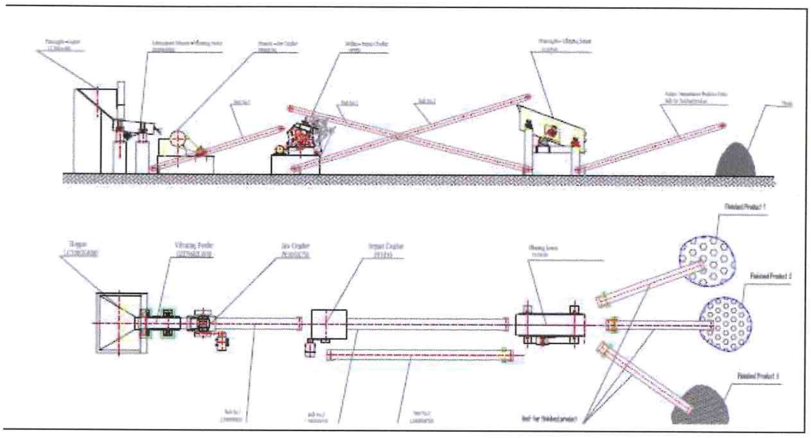
4. Dumping area: standard sludge (hum. =/< 20%) mixed with expanded clay (and/or natural soil and fertilizer) and small debris to expand level of permeability, natural drainage of the dumped sludge to avoid land solidification (so called 'stone process').
Mixing formula will depend on a number of local factors and must be determined on site.

5. Finally 1 Meterof good agricultural soil with natural fertilizer for further land cultivation.

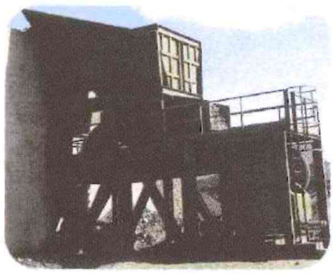
Fig. 1: taken from a real abandoned quarry in Al Arrub, is a rough design describing this process:



In order to rehabilitate quarries and dump sludge and debris it is necessary to re organize and prepare the entire surrounding area. equipment based on two crushing lines with automated loading and a mixing system will also be needed:



**One storage / discharge area for preparation of different materials:**



Alimentazione di frantoio primario da 750 mm.
Feed of 750 mm. primarj jaw crusher.
Alimentation de concasseur primaire de 750 mm.

Alimentazione di granulatore da 800 mm.
Feed of 800 mm. jaw granulator.
Alimentation de gravilloneur de 800 mm.

**One storage / discharge area for preparation of different materials:**

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DoE (1992). The Use of Land for Amenity Purposes. Publ. HMSO, UK
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Segregated storage of wastes in a designated area (Roadstone Provinces Ltd., Bunratty, Co. Clare)

## ANNEX 3:MANAGEMENT OF THE MULTI UTILITY OPERATIONAL MANUAL

**1 SCOPE**
Scope of this Operational Manual is to give a full overview of duties and tasks, internal procedure, forms, job description and organizational chart for the experimental plant specialized in the treatment of sludge and recycling of industrial water.

**2 APPLICATION FIELD**
Application field of this Operational Manual is strictly restricted to the people involved in the task related to the activity of the company ('Multi Utility') in charge of the treatment and collection of sludge, treating the recycled water within the facility, and supplying recycled water to the companies of the so called 'Hebron Marble District', stocking and storaging all the raw material coming from the treatment process.

**3. KEY PERSONS INVOLVED IN THE TASK**
Here below is a detailed description of key persons involved in the main task:

*UNIT MANAGEMENT:*
Responsible for managing the special Unit of Recycled Water of the Hebron Municipality. He/she will carry out all the necessary tasks in order to achieve the foreseen results of supplying recycled water to companies in the Hebron district by reducing environmental risks due to illegal sludge disposal

*ACCOUNTANT PLANNER:*
Responsible for collecting, keeping and processing all the administrative data and information – such as invoices, bills, time sheets, forms for the uploading and downloading of recycled water, storage of material etc.

In ANNEX 1 the "Model 026T" to record collection of sludge and discharge of water

**4. DESCRIPTION OF THE ACTIVITIES**
A detailed description of the main activities here follows:

**1.**Planning of the activities on a daily schedule basis and weekly basis. The Office Manager in charge of planning must provide a general plan for the activities related to sludge collection from local companies. He/She will give all the instructions needed to the truck drivers (public or private tankers) in order to collect the sludge from the site, transport the sludge to the site of the plant for the treatment. Furthermore He/She will keep records (and files and documents) of all the daily trips, with the day and hour of the service, name of the company, the total amount of the sludge collected, the number plate of the truck/tanker used for transportation and the total amount of sludge and or water recycled, with a final space for the signature. Model 026T will be used for this purpose.

**2.**Planning and billing. Office Manager in charge of Accountancy. He/She is responsible for organizing all the records of file and documents needed for the invoicing, cashing, supervision of administrative tasks in order to supply all the documents upon request (Unit Manager of Water Dept by the Hebron Municipality)

**3.**Truck driver will be responsible for collecting sludge from the site of the company to the plant for the treatment. Furthermore he will be responsible for bringing recycled water to the companies – on request. He will also be responsible for the maintenance of the truck and will highlight any inconvenience that may occur to the Unit Manager in order to provide a full service on apermanent basis to the companies

**4.**Maintenance of the plant. The Unit manager will be responsible for the maintenance of the plant. A Worker will be in charge to ensure the total efficiency of the plant checking on a daily and weekly basis in order to make sure the machinery for the treatment of the sludge and the recycle of water is in perfect working order He will inform the Unit Manager about any spare parts – if needed – to be changed or repaired so to ensure the steady operational running of the machinery.
Periodical chemical analysis of the recycled water will be carried out. In ANNEX 2 the parameters to be checked by the lab in the Hebron Municipality (Water Dept).

**5.**Stocking and storage of sludge . Once sludge is downloaded to the plant and has undergone the full cycle, the person in charge will be responsible for the stocking and storage of the residuals in the municipal landfill . He will be responsible for filling in the related documents in order to ensure a detailed bill of quantity of the raw material stocked in the plant

**6.**Waste acceptance and Disposal.This section of the document discusses what kind of waste to be accepted and/or disposed of at sludge facility. For the purpose of this section, "acceptance" of waste occurs when the owner or operator of the facility has permitted a tanker to proceed to the unloading zone.
Disposing of wastes must be carried out in controlled landfills to prevent any contamination to water and soil. The main responsibility throughout this phase lies with the Management of the plant.

A. The above mentioned residuals must be readily identifiable as sludge prior to acceptance by the facility and must not be shredded or pulverized, unless exempted by the licensing authority.

B. Any waste not recognizable as sludge will not be accepted.

C. Owners or operators of a facility will not accept any hazardous wastes, infectious wastes, or containerized or bulk liquids.

D. Neither can liquid wastes, such as paint or varnish, which have been solidified be accepted for disposal. If any of these prohibited materials are detected in incoming loads, the entire load must be refused.

E. Owners or operators of facilities will not dispose of any different solid wastes than the above mentioned materials.

F. Exemptions. A marble and sludge facility, however, can dispose "exempt" materials only if the owner or operator receives the authorization required by the relevant Authority.

G. Operators may need to contact the marble and sludge facility to ensure the facility has the proper authorization for acceptance of these materials.

**7.**Reuse technique. The reuse technique is defined as re-employment of materials to be reused in the same application or to be used in lower grade applications. The Operators have the major responsibility for adopting the reuse techniques in the project throughout the execution phase, as follows:

**Collection procedures**

- Separation/segregation/sorting techniques should be implemented to the waste stream.
- Labelled containers for each waste stream and a schedule of the pick-up times of the containers should be provided.
- On-site storage areas to dump the containers should be designated. In order to prolong the waste life and extend the reusable abilities, the storage areas should be:

(1) remote enough from the site to limit access to the stored material and hence control its contamination;
(2) labelled by large signs to describe the purpose of the area and
(3) protected from weather conditions, such as rain and dust.

## 5. JOB DESCRIPTION TASK AND DUTIES

Following is a detailed description of the task and duties:

### UNIT MANAGEMENT

**SCOPE OF THE POSITION**
Responsibility of managing the special Unit of Recycled Water of Hebron Municipality. He/she will carry out all the necessary tasks in order to achieve the foreseen results to supplying recycled water to companies in Hebron's district by reducing environmental risk due to illegal sludge disposal and to grant the necessary sustainability to the plant

1. Supervision of the activities to be carried out in the special unit of recycle water.
2. Supervision of the billing process to companies and issuing the administrative documentation upon request.
3. Reporting to the chief of Central Department of Water in Hebron Municipality on a weekly basis about all the problems that may arise in supplying the service to companies.
4. Implementation of all the tasks and necessary modifications in order to improve the quality of the service.
5. Supervision of the file record, technical manual - safeguarding of documents in an appropriate place.
6. Supervision and coordination of shift work on the site in order to supply daily service to companies.
7. Supervision of storage of all material (such like calcium carbonate) in specific tanks or silos.
8. Supervision and need analysis of training when needed in order to improve the technical skills of personnel employed.
9. Organization of periodic surveys – through meetings, interviews, questionnaires - with local companies in order to improve the quality of the service, reducing risks on the site and evaluation of technical modifications if needed.
10. Responsible for the implementation of all the requirements to be fulfilled for the safety of the technicians employed on the site.
11. Supervision of technicians employed on the site in order to give clear technical instructions when needed
12. Screening of mail correspondence.
13. Responsibility of keeping billings in order.
14. Supervision of demand for spare parts to be submitted to the Chief of Water Department for buying and replacing.

## ACCOUNTANT –PLANNER

**SCOPE OF THE POSITION**

Person in charge of this position is responsible for collecting, keeping and processing all the administrative data and information – such as invoices, billings, work shifts, forms for uploading and downloading recycled water, storage of material etc

TASK AND REPONSABILITIES

1. Safeguarding all the files, record documentation, company contracts in a appropriate place in order to retrieve all or any the documentation when needed.
2. Giving instructions to the truck drivers (eg. Forms for collecting uploading and downloading of sludge, recycled water, debris etc.) in order to supply the service to companies of Hebron district.
3. Organization of daily – and weekly planning rosters - in order to distribute the forms for daily courses aimed at collecting sludge and bringing back recycled water to truck drivers.
4. Keeping contact with companies (such as answering phone calls – e-mail communication - of the Hebron district and updating the information in order to identify critical aspects that could arise when supplying the service and in any case organize the service of uploading and downloading.
5. Updating all data using software – especially created to suit the task – of billing and issuing the invoice to companies.
6. Make all information available to companies for the supplying of the service such as contract forms, information on delivery of the service, fares and tariffs.

**6. DEFINTIONS**

1 - "Marble and stone debris" or "debris" means those solid materials resulting from the extraction, alteration, construction, destruction, rehabilitation, or repair of marble and stone or their manufacture,

2 - "Marble and stone sludges" or "Sludges" mean the liquid residuals from the marble and stone cutting and production, mostly with cutting machinery like H/V Cutters and Circular Cutters, composed of water and stone powder in percentage not less than 90%
Solid residuals from mining and extracting activities destined to the effective use for ground filling do not constitute waste and therefore are excluded from the application of these rules.
The residuals of mines and quarries extracting activities are not considered refusal activities when re-used without the above mentioned preliminary transformations.

3 - "Operators" refers to any subject, singular or under any company denomination or organization, which operates for commercial purposes within the above mentioned activities.

4 - "Marble and stone debris and sludges facility" or "facility" means any site, location, tract of land, installation, or building used for the disposal of debris and sludges.

5 - "Disposal" means the discharge, deposit, injection, dumping, spilling, leaking, emitting, or placing of any marble and stone debris and sludges into or on any land or ground or surface water or into the air, except if the disposition or placement constitutes storage, reuse, or recycling in a beneficial manner.

6 - "Licensing authority" means a city or county department which is approved by the Hebron district authority.

7 - “Storage” means the holding of debris and sludge for a temporary period of time and in such a manner that the debris and sludge remain retrievable and substantially unchanged and, at the end of the period, are disposed, reused, or recycled in a beneficial manner.

8 - “Contractors” means the owners and the operators of authorized marble and stone debris and sludge facilities.

ANNEX 1

REGISTER FOR SLUDGE COLLECTION - Model 026T -

| Date | Hour | Company | Plate Nr. | Qty | Signature |
|---|---|---|---|---|---|
| | | | | | |
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ANNEX 2

WATER CHEMICAL PARAMETERS TO BE TESTED FOR QUALITY INSPECTIONS

| | Unit | Ref. Norms |
|---|---|---|
| Water Hardness in °F | °F | IRSA2040 |
| Sodium | mg/l Na | IRSA3030 |
| Potassium | mg/l K | IRSA3030 |
| Calcium | Mg/l Ca | IRSA3030 |
| Magnesium | pH | IRSA3030 |
| Ionian Concentration H° | uS/cm3 | IRSA2060 |
| Electrical Conductivity 20°C | mg/l | IRSA2030 |
| Fixed Residual 180°C | mg/l Ct | UNI10506 |
| Chlorides | mg/l Cl2 | EPA325.1 |
| Free Residual Chlorine | mg/l NH2 | EPA335.2 |
| Ammonia | mg/l NO2 | IRSA3030 |
| Nitrites | mg/l NO3 | IRSA4020 |
| Nitrates | mg/l O2 | IRSA4020 |
| Oxidab. | mg/l Fe | KUBEL |
| Iron | mg/l P2O4 | APHA3500 |
| Total Phosphorus | mg/l SO4 | IRSA4020 |
| Sulfates | mg/l SO4 | IRSA4020 |
| Sulfides | mg/l S" | STRIPPING |

**Conformity**

**Non Conformity**

ANNEX 4
Feasibility Studies

**Component 1 : Water Recycling Prototype**

FEASIBILITY STUDY
PROTOTYPE FOR THE TREATMENT OF WASTEWATER OF THE MARBLE INDUSTRY
HEBRON MUNICIPALITY – AGENFOR ITALIA

**INVESTIMENT PLAN**

| | |
|---|---|
| **INVESTIMENT** | **1.250.000** |
| Prototype (design and building)-EU Financing | 1224000 |
| Extraordinary Maintenance per year | 5000 |
| Planned Maintenance per year | 20000 |

**PROFIT & LOSS ACCOUNTS**

| | | | |
|---|---|---|---|
| **Total Costs** | **599,54** | **131.900** | **100%** |
| **Investments** | **136,36** | **30000** | **22,74%** |
| Prototype | 0 | 0 | |
| Extraordinary Maintenance per year | 22,72 | 5000 | |
| Planned Maintenance per year | 45,45 | 10000 | |
| Tankers Maintenance | 68,18 | 15000 | |
| **Staff Costs** | **284,54** | **62600** | **47,46%** |
| Staff | 261,81 | 57600 | |
| Office Cost | 22,73 | 5000 | |
| **Production Cost** | **158,18** | **34800** | **26,38%** |
| Fuel | 58,18 | 12800 | |
| Electric Power | 100 | 22000 | |
| Water | 0 | 0 | |
| **Marketing & Sales Cost** | **20,45** | **4500** | **3,41%** |
| Advertising | 20,45 | 4500 | |
| **Revenues** | **808,56** | **177883** | **100%** |
| Water | 433,55 | 95383 | 53,62% |
| Sludge Collection, transportation and dumping | 375 | 82500 | 46,38% |
| **GROSS PROFIT** | **209,01** | **45.983** | **25,85%** |

## ASSUMPTIONS

The basis of this Feasibility Study are represented by the following assumptions :

**Revenues:**

- The production capacity/year of the prototype is calculated for 110.220 m3 water, that is to say 501 m3/day x 220 days. We consider the

  - the level of humidity of the pressed sludge (20/22%) and also
  - the fact that 8-10% of the companies will bring sludge with a low level of water (time of collection, pre-treatments, ecc.) to the prototype

- The collection capacity of the Municipality is estimated at 5.500 transports. Each transport has a value of € 15,00. The average capacity of the tankers is 12T.

- Sale price of the water has been calculated at 4,4 NIS., that is to say below the actual cost

**Costs:**

We have not included the pay off of the investment for the prototype, in the calculation because it based on a EU-grant.

*Labour costs are at actual Palestinian salaries.*

## Component 2 : Calcium Carbonate Plant

FEASIBILITY STUDY
PLANT FOR THE TREATMENT OF THE CALCIUM CARBONATE RECYCLED FROM THE PROTOTYPE
HEBRON MUNICIPALITY – AGENFOR ITALIA

### Financial Appraisal Investment Plan

| Investments | € 2.060.000,00 |
|---|---|
| Plants | € 1.695.000,00 |
| Infrastructure | € 250.000,00 |
| Design | € 100.000,00 |
| Extraordinary Maintenance per Year | € 5.000,00 |
| Planned Maintenance per Year | € 10.000,00 |

**Profit & Loss Accounts**

| | Day | Year | |
|---|---|---|---|
| Total Costs | € 2.506,68 | € 551.470,00 | 96,37% |
| | | | |
| Investments | € 532,95 | € 117.250,00 | |
| Plants | € 385,23 | € 84.750,00 | 15,37% |
| Infrastructure | € 56,82 | € 12.500,00 | 2,27% |
| Design | € 22,73 | € 5.000,00 | 0,91% |
| Extraordinary Maintenance per Year | € 22,73 | € 5.000,00 | 0,91% |
| Planned Maintenance per Year | € 45,45 | € 10.000,00 | 1,81% |
| | | | |
| Staff Cost | € 854,55 | € 188.000,00 | |
| Staff | € 809,09 | € 178.000,00 | 32,28% |
| Office Cost | € 45,45 | € 10.000,00 | 1,81% |
| | | | |
| Production Cost | € 801,00 | € 176.220,00 | |
| Fuel | € 525,00 | € 115.500,00 | 20,94% |
| Electric Power | € 276,00 | € 60.720,00 | 11,01% |
| Wet Sludge | € - | € - | 0,00% |
| | | | |
| Marketing & Sales Costs | € 318,18 | € 70.000,00 | |
| Commercial Staff | € 90,91 | € 20.000,00 | 3,63% |
| journey Costs | € 90,91 | € 20.000,00 | 3,63% |
| advertising | € 45,45 | € 10.000,00 | 1,81% |
| Fair & Exposition | € 90,91 | € 20.000,00 | 3,63% |
| | | | |
| Revenues | € 4.000,00 | € 880.000,00 | |
| | | | |
| Gross Profit | € 1.493,32 | € 328.530,00 | 37,33% |

| Abstract | | | |
| --- | --- | --- | --- |
| Company Costs | € 2.506,68 | € 551.470,00 | 62,67% |
| Company Profit | € 493,32 | € 108.530,00 | 12,33% |
| Reseller | € 600,00 | € 132.000,00 | 15,00% |
| Transports | € 400,00 | € 88.000,00 | 10,00% |

## Assumptions

| Assumptions | |
| --- | --- |
| Production Capacity/Year | Kg 17.600.000 |
| Production Capacity/Day | Kg 80.000 |
| Days per Year | 220 |
| Amortization (years) | 20 |

| Fuel Costs | |
| --- | --- |
| Calcium Carbonate Kg per 1 kg fuel | Kg 53 |
| Fuel Needs per Day | Kg 1.500 |
| Fuel cost per kg | € 0,35 |
| Fuel Cost per Day | € 525,00 |

| Electric Power Cost | |
| --- | --- |
| KWH/Day | 3000 |
| KWH Cost | € 0,09 |
| Electric Power Cost per day | € 276,00 |

| Row Material Cost | 0 |
| --- | --- |
| Wet Sludge | € - |
| - | Kg - |
| - | € - |

| Staff & Labor Cost | Unit | Unit Cost | Total Cost |
| --- | --- | --- | --- |
| Director | 1 | € 30.000,00 | € 30.000,00 |
| Manager | 4 | € 25.000,00 | € 100.000,00 |
| Workers | 4 | € 12.000,00 | € 48.000,00 |
| Sales | 1 | € 20.000,00 | € 20.000,00 |
| Total Cost | 10 | | € 198.000,00 |

| Costo fo Final Product | |
| --- | --- |
| Cost FP per KG | € 0,03 |
| Cost FP per ton | € 30,20 |
| ton Price | € 50,00 |

## Comments

With reference to the type of product and because of the presence of potential competitors on the market of the Palestine (West Bank) neighbouring countries, Jordan, Saudi Arabia, Egypt, Turkey an incisive marketing action will be needed. This still has to be defined.
The costs to be met with and relative to marketing only take into consideration the beginning of the sales operations to maintain the factory costs.
Another strategic factor is the cost of the fuel, when the supply of fuel from countries outside Israel at competitive prices will sensibly increase the profits. For example, given the role of Saudi Arabia in the formation of the new Palestinian Government (Mekka Agreement) an agreement with Saudi companies to buy fuel at subsidized prices for Palestine.
It is thought that the overall economic assessment of costs and profits (even though it is not yet thorough ) indicates an interesting economic feasibility.

**To set out these two pre-feasibility studies, the following points have been considered:**

- International market availability of simple and good-quality equipment, plant and technology, lined up to modern standards of efficiency, reliability and safety.
- Visit to factories of equipment related to the processes to be implemented.
- Visit to some factories that use the proposal process, process analysis and evaluation of company's plan.
- Availability and ready to use site, near to the main stone and marble districts; fair surface site, easy road network and licence.
- Proposal of staff and labour with necessary know-how on factory management, plant management, health, safety and environment.
- Scheme of an implementation plan.
- Report of a profit and loss plan.

**Output**

This pre-feasibility study leads to a positive assessment of the plan, according to:

Easy application of these technologies in the sector of the stone and marble industry in Palestine (West Bank) Managerial and financial plausabilty of the enterprise.

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